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# Biology Education Across the Life Course: A Qualitative Study of Learning Trajectories and Meaning-Making

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## Abstract

Biology education research has predominantly relied on cross-sectional approaches that focus on learning outcomes at specific educational stages, providing limited insight into how engagement with biology develops longitudinally across the lifespan. This study addresses this gap by adopting a qualitative life course perspective to explore how individuals experience, interpret, and construct meaning around biology education across multiple life stages. Data were collected through in-depth, semi-structured life history interviews with 12 participants who had engaged in formal biology education across secondary, higher, and post-formal educational contexts, and were selected using purposive maximum variation sampling. The interview data were analyzed using thematic narrative analysis informed by life course concepts. The findings indicate that early encounters with biology education function as foundational reference points shaping long-term orientations toward the subject, while educational transitions act as critical turning points that redirect engagement and motivation. Additionally, the meaning of biology learning was found to be dynamic and context-dependent, often emerging or being reconstructed beyond formal schooling in response to changing life circumstances. The theoretical contribution of this study lies in reconceptualizing biology education as a longitudinal, life course process, thereby extending stage-bound and linear models of biology learning. These findings have important implications for biology education research and practice by emphasizing the need for pedagogical approaches that support continuity, relevance, and sustained meaning-making across the lifespan.

**Keywords:** Biology Education; Learning Trajectories; Life Course; Meaning-Making; Transitions

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## INTRODUCTION

Biology education research has traditionally focused on discrete stages of formal learning, such as classroom-based interventions, curriculum design initiatives, and the implementation of specific pedagogical strategies, which have provided valuable insights into how learners engage with biological concepts at particular moments within formal educational settings, while offering limited understanding of how such engagement evolves beyond these bounded instructional contexts over time [1], [2], [3]. However, there is increasing recognition that learning in biology, as in other domains of science education, is not a discrete or isolated process but is embedded within broader patterns of human development that unfold across the life course. From this perspective, learning is understood as cumulative, shaped by experiences that extend beyond formal educational settings and continue to evolve over time. The life course perspective, originating in sociology and interdisciplinary social science research, emphasizes the importance of temporal sequencing, social contexts, and historical positioning in shaping individual developmental trajectories. By foregrounding the interplay between timing, life transitions, and contextual influences, this perspective offers a conceptual framework for understanding how biology learning is continuously constructed, reinterpreted, and given meaning across different stages of life [4], [5], [6]. This framework foregrounds the idea that learning is not a discrete or isolated event but unfolds as a developmental trajectory characterized by multiple transitions, turning points, and sequential experiences, which interact cumulatively over time to shape learners' later educational orientations, engagement, and outcomes [7], [8], [9]. Therefore, applying a life course lens to biology education can extend our understanding beyond isolated learning episodes by situating learners' cognitive, affective, and experiential processes within the broader arc of their lives.

Central to the life course perspective are the interrelated concepts of trajectories, transitions, and linked lives, which collectively explain how individuals move through sequences of roles, relationships, and experiences over time. These concepts emphasize that human development is not linear or isolated, but unfolds through patterned pathways shaped by critical turning points and interconnected social relationships across the lifespan [10], [11], [12]. Trajectories refer to long-term patterns of relative stability and change within a particular domain of experience, capturing how individuals' engagement, orientations, or practices unfold over time, whereas transitions denote specific shifts in status, role, or context that punctuate these trajectories and often mark moments of reorientation or redirection [12], [13], [14]. The concept of linked lives underscores the interdependence of individuals' life pathways with their surrounding social contexts, encompassing relationships with family members, educational institutions, peer networks, and broader cultural environments that collectively shape learning experiences and developmental trajectories over time [15], [16], [17]. Although this conceptual apparatus has been widely employed in sociological research on health, employment, and educational attainment, it remains underutilized within biology education research, where the focus more commonly emphasizes short term instructional efficacy rather than longitudinal meaning-making and developmental patterns [18], [19], [20].

Biology education itself is an emergent interdisciplinary field that seeks to build integrative theoretical and empirical frameworks for understanding how learners conceptualize living systems, how their ideas about biological phenomena develop and change over time, and how teaching practices and learning environments can be designed to foster deep conceptual change rather than surface-level understanding [11], [21], [22]. Much of the influential work in this area has focused on cognitive and pedagogical interventions, yet there is a significant gap in understanding how

learners' biological knowledge, identity, and engagement with biology evolve over the life course. For example, while prior studies have explored students' conceptual understanding of evolution or genetics within specific academic contexts, they typically do not account for how earlier educational experiences, personal transitions, or broader life trajectories inform learners' long term engagement with biology [23], [24], [25]. There is also limited qualitative research that explores how learners interpret and integrate their biology learning across different life stages, such as transitions from secondary schooling to higher education, professional practice, or participation in public life. As a result, little is known about how biological knowledge is carried forward, reinterpreted, or transformed as individuals encounter new institutional, social, and personal contexts over time. This limitation highlights a critical knowledge gap at the intersection of life course studies and discipline-based education research, where learners' developmental trajectories, educational transitions, and evolving meaning-making processes remain insufficiently understood.

Despite the growing body of research in biology education that has extensively examined instructional strategies, curriculum design, and short-term learning outcomes, existing studies remain largely cross-sectional and confined to specific stages of formal education, such as secondary or higher education contexts. Consequently, the current literature offers limited understanding of how individuals' engagement with biology learning unfolds over time, including how it is sustained, diminished, or reconfigured as learners move across educational, professional, and personal life phases. This stage-bound focus obscures the cumulative and developmental nature of biology learning, leaving insufficient insight into how early educational experiences interact with later life contexts to shape evolving patterns of engagement and meaning-making across the life course.

At the same time, life course theory has been extensively applied in sociological and educational research to explain trajectories, transitions, and developmental patterns across the lifespan, particularly in domains such as health, employment, and general educational attainment. Within these fields, the life course perspective has been widely used to examine how early experiences, critical transitions, and contextual factors interact over time to shape long-term outcomes. However, despite its strong explanatory potential, this theoretical framework has rarely been systematically applied to discipline-specific education research. In the context of biology education, learning is still predominantly conceptualized as an outcome of discrete instructional interventions, short-term pedagogical strategies, or stage-bound educational experiences. As a result, biology learning is often examined in isolation from learners' broader developmental trajectories and life contexts, limiting understanding of how biological knowledge, engagement, and meaning-making accumulate, evolve, or are reinterpreted over time. This gap highlights the need for research that reconceptualizes biology education as a cumulative and longitudinal process, informed by life course theory, in order to capture the dynamic and developmental nature of learning across the lifespan.

Consequently, there remains a significant lack of qualitative evidence that explains in depth how early experiences in biology education shape individuals' long-term learning trajectories across different stages of life. Existing research has yet to sufficiently illuminate how educational transitions such as movement between schooling levels or from formal education into broader life and professional contexts function as critical turning points that influence sustained engagement with biology learning. Moreover, little is known about how the meaning of biology learning is continuously reconstructed over time, particularly beyond the boundaries of formal schooling, as

individuals encounter new personal, social, and contextual demands. Addressing this gap is essential for advancing a more holistic and developmentally informed understanding of biology education, one that recognizes learning as a dynamic and cumulative process characterized by both continuity and change, and that accounts for the evolving ways in which learners construct and negotiate the relevance and meaning of biology knowledge across the lifespan.

Based on the identified research gap, this study is guided by the following research questions: 1). How do individuals describe their learning trajectories in biology education across different stages of the life course? 2). How do educational transitions (e.g., from secondary to higher education or from formal education to everyday and professional contexts) function as turning points in individuals' engagement with biology learning? 3). How do individuals construct and reconstruct the meaning of biology education as they integrate biological knowledge into their personal, social, and professional lives over time?

## METHODS

This study employed a qualitative research design grounded in a life course perspective to explore how individuals experience, interpret, and construct meaning around biology education across different stages of their lives. This perspective enabled the study to attend to patterns of continuity and change in learning experiences over time, as well as to the influence of educational transitions and life contexts on participants' engagement with biology. A qualitative approach was considered particularly appropriate because the research aimed to capture participants' subjective experiences, personal narratives, and interpretive accounts of their learning trajectories, which are inherently contextual and temporally situated. Such experiences, including shifts in motivation, relevance, and meaning-making, cannot be adequately examined through quantitative measures that prioritize standardized outcomes or cross-sectional comparisons. Instead, a qualitative design allows for an in-depth exploration of how participants make sense of biology education as a cumulative and evolving process shaped by both formal educational experiences and broader life circumstances [26], [27], [28]. The life course framework guided the study design by emphasizing temporal sequencing, educational transitions, and the influence of changing social, institutional, and personal contexts in shaping participants' experiences and interpretations of biology education over time, allowing the study to capture patterns of continuity and change across different stages of the lifespan.

### *Research Design*

This study adopted a qualitative research design grounded in a life course perspective to examine how individuals experience, interpret, and construct meaning around biology education across different stages of their lives. This approach enabled an in-depth exploration of participants' narratives as they reflected on their biology learning experiences over time, allowing the study to capture not only what was learned but also how these experiences were perceived, reinterpreted, and integrated into broader life trajectories. A qualitative life course design was considered particularly appropriate because the research aimed to investigate longitudinal learning trajectories, key educational transitions, and evolving processes of meaning-making that unfold across extended periods and are often shaped by shifting social, institutional, and personal contexts. Such complex

and temporally situated processes cannot be adequately examined through cross-sectional or quantitative designs, which tend to prioritize static outcomes over developmental change.

By emphasizing temporal sequencing, continuity and change, and the influence of contextual factors, this research design aligns closely with the theoretical foundations of life course research and qualitative educational inquiry. It allows for an analysis of how early biology education experiences function as reference points for later learning, how transitions between educational stages or life roles operate as turning points, and how meanings attributed to biology knowledge are reconstructed in response to changing life circumstances. Through this lens, biology education is conceptualized not as a series of isolated instructional events, but as a cumulative and dynamic process that unfolds across the lifespan, thereby providing a more holistic understanding of learning and engagement with biology over time.

### *Participants and Sampling*

The participants consisted of twelve individuals who had engaged in formal biology education across multiple educational stages, including secondary schooling, higher education, and post-formal or professional contexts. This criterion was intended to ensure that participants possessed sufficiently varied and sustained experiences with biology learning to support retrospective reflection across different phases of the life course. Participants were selected using purposive sampling combined with a maximum variation strategy, enabling the study to capture a broad range of educational pathways, life stages, and experiential backgrounds related to biology education. Inclusion criteria required participants to have completed at least secondary-level biology education, to possess learning experiences spanning more than one educational or life stage, and to demonstrate a willingness and capacity to reflect retrospectively on their biology learning experiences over time.

The participants ranged in age from 23 to 48 years and represented diverse academic and professional trajectories, thereby allowing for meaningful comparison across different life contexts and stages of development. Data collection and sampling proceeded iteratively and continued until thematic saturation was reached, as indicated by the repetition of key themes and the absence of substantively new analytical insights in subsequent interviews. This sampling approach strengthened the depth, credibility, and analytical rigor of the qualitative findings by ensuring both experiential diversity and conceptual redundancy, while also supporting cross-case comparison within and across identified learning trajectories.

### *Research Instrument*

The primary research instrument for this study was a semi-structured life history interview guide, meticulously developed in alignment with the theoretical framework of life course theory. This interview protocol was intentionally designed to include a series of open-ended questions aimed at eliciting rich, detailed narratives from participants regarding their experiences with biology education, spanning from their earliest encounters in formal schooling to their present life stage. The key areas of inquiry encompassed participants' initial exposure to biology, the critical educational transitions they experienced, the influence of social and institutional contexts on their learning trajectories, and the personal meanings they attributed to biology learning throughout their lives. The flexible and adaptive structure of the interview guide allowed participants to highlight and elaborate on experiences that they personally deemed significant, providing depth and nuance



to their narratives, while simultaneously ensuring that the data collected remained closely aligned with the study's analytical framework and research objectives. This approach not only facilitated comprehensive documentation of participants' longitudinal learning experiences but also enabled the capture of individual variations and subjective interpretations that are central to understanding the dynamic, context-dependent processes of biology learning across the life course.

### *Data Collection Procedure*

Data were collected through in-depth, semi-structured life history interviews, which were carefully designed and guided by the principles of life course theory to ensure that participants' experiences could be explored within their temporal, social, and contextual dimensions. An interview protocol was developed specifically to elicit rich, detailed narratives about participants' experiences with biology learning from their earliest encounters in formal schooling through to their current educational or professional stages. The protocol included a set of open-ended questions that encouraged participants to reflect on significant moments, transitions, and the meanings they attributed to biology learning over time, while allowing them the flexibility to discuss experiences they perceived as personally important or formative. Core areas of inquiry focused on initial engagement with biology, the impact of significant educational transitions, the role of influential social and institutional contexts, and the ways in which participants reconstructed or reinterpreted the relevance and significance of biology knowledge throughout their lives.

Interviews were conducted individually over a period of three months, using either face-to-face meetings or secure online platforms depending on participants' availability, geographic location, and personal preferences, ensuring both accessibility and ethical compliance. Each session lasted approximately 60–90 minutes, providing sufficient time for participants to engage in reflective and detailed discussion. All interviews were audio-recorded with participants' informed consent, ensuring accuracy and completeness of data capture. To facilitate thorough analysis, every recording was transcribed verbatim, producing precise textual records that preserved participants' words, expressions, and nuances of meaning, thereby enabling a rigorous and systematic thematic narrative analysis that remained faithful to participants' lived experiences.

### *Data Analytics*

Data analysis followed a thematic narrative analytic approach informed by life course concepts. Analysis proceeded through several iterative stages. First, open coding was conducted to identify salient segments related to learning experiences, transitions, and meaning-making. Second, codes were grouped into higher-order categories reflecting key life course constructs, including trajectories, timing, continuity and change, and contextual influences. Third, themes were refined through constant comparative analysis across cases to identify shared patterns as well as divergent pathways. Throughout the analytic process, reflexive memos were maintained to document analytical decisions and enhance theoretical sensitivity. The integration of inductive and theory-guided coding enabled a nuanced interpretation of participants' narratives while maintaining conceptual alignment with life course theory.

### *Trustworthiness and Rigor*

To enhance the trustworthiness of the study, multiple validation strategies were employed. Member checking was conducted by inviting participants to review interpretive summaries of their narratives

to confirm accuracy and resonance with their experiences. Peer debriefing with qualitative research colleagues was used to critically examine coding decisions and thematic interpretations. An audit trail was maintained to document methodological and analytical procedures, supporting transparency and dependability.

### *Ethical Considerations*

Ethical approval for the study was obtained from the relevant institutional review board. All participants provided informed consent prior to data collection and were assured of confidentiality and voluntary participation. Pseudonyms were used in all transcripts and reports, and data were securely stored in password-protected files accessible only to the research team.

## **RESULT AND DISCUSSIONS**

The findings are presented thematically to reflect participants' narrated experiences of biology education across the life course. Three interrelated themes emerged from the analysis: (1) early encounters with biology education as foundations of learning trajectories, (2) educational transitions as turning points in engagement with biology learning, and (3) meaning-making and continuity of biology learning across life stages.

### *Early Encounters with Biology Education: Foundations of Learning Trajectories*

Participants consistently described their early experiences with biology education primarily during secondary schooling as formative in shaping their initial orientations toward the subject. Many participants recalled that biology learning was dominated by memorization and examination-oriented instruction, which limited their engagement and understanding of the relevance of biological concepts.

One participant explained:

"In high school, biology was mostly about memorizing terms for exams. I studied hard, but I didn't really understand how it connected to real life." (Participant 2)

Similarly, another participant noted:

"Biology felt difficult and abstract because we rarely discussed why the concepts mattered. It was more about finishing the syllabus." (Participant 6)

In contrast, participants who experienced contextualized learning activities, such as laboratory experiments or field observations, described more positive early encounters with biology education. These experiences fostered curiosity and sustained interest:

"When we did experiments or observed plants directly, biology became interesting. Those moments stayed with me longer than the textbook lessons." (Participant 5)

These early encounters functioned as the foundation upon which later learning trajectories were constructed, shaping whether participants maintained or disengaged from biology learning in subsequent stages.

### *Educational Transitions as Turning Points in Biology Learning*

Educational transitions were frequently identified as critical turning points that reshaped participants' relationships with biology education. Transitions from secondary school to higher education, as well as from formal education to professional or everyday contexts, often marked shifts in how biology was perceived and valued.



Several participants described the transition to university as a moment when biology learning gained conceptual depth and intellectual relevance:

“At university, biology was no longer just facts to memorize. We were encouraged to ask questions and think critically, which changed how I engaged with the subject.” (Participant 7)

However, other participants experienced transitions as moments of discontinuity and disengagement. For some, biology became increasingly specialized and disconnected from personal or professional goals:

“After graduating, biology felt very far from my daily work. I stopped thinking about it because it didn’t seem relevant anymore.” (Participant 4)

These contrasting experiences highlight how educational transitions can redirect biology learning trajectories either toward renewed engagement or gradual disengagement, depending on institutional contexts and pedagogical approaches.

### *Meaning-Making Across the Life Course*

Participants described meaning-making as an ongoing process that evolved across different life stages. Many emphasized that the significance of biology education was not fixed during formal schooling but was often reconstructed later in life as biological knowledge became relevant to personal, social, or professional contexts.

One participant reflected:

“I only realized how important biology was later in life, especially when making health decisions for my family. Things I learned years ago suddenly made sense.” (Participant 9)

Another participant noted:

“Biology didn’t mean much to me in school, but now I see it everywhere in food choices, environmental issues, and even news about diseases.” (Participant 1)

These accounts indicate that biology learning outcomes may emerge cumulatively and longitudinally, shaped by changing life circumstances rather than immediate instructional effects.

### *Discussion*

This study was undertaken to address a persistent gap in biology education research, namely the predominance of cross-sectional analyses and the limited attention to how biology learning develops longitudinally across the life course. Previous scholarship has emphasized the importance of relevance, learner engagement, and motivational dimensions in science education. Research by Cleveland et al. [29] as well as the broader developmental and contextual factors that shape learning experiences over time. Similarly, Osher et al. [30] and Glynn et al. [31] these perspectives have rarely been integrated to examine how biology learning trajectories unfold across multiple life stages. The present findings extend this literature by demonstrating that engagement with biology education is cumulative, shaped by early experiences, educational transitions, and evolving processes of meaning-making across the lifespan.

Consistent with Cleveland’s [29] argument that science learning becomes meaningful when it is perceived as relevant to learners’ lives, the findings show that early encounters with biology education strongly influence long-term orientations toward the subject. Participants who experienced biology as abstract and examination-oriented during early schooling often reported disengagement that persisted into later stages. At the same time, this study extends Cleveland’s work by illustrating that early relevance does not function as a fixed determinant; rather, its effects

may be reactivated or reinterpreted later in life as learners encounter new contexts in which biological knowledge becomes meaningful. This longitudinal perspective directly addresses the gap in prior research that has focused primarily on immediate instructional outcomes.

The findings also resonate with Glynn's [31] emphasis on motivation as a key factor in science learning. Participants' narratives suggest that motivation to engage with biology fluctuates across educational stages and life contexts, rather than remaining stable over time. Educational transitions, in particular, emerged as critical moments in which motivation was either strengthened or diminished. While Glynn [31] conceptualizes motivation largely within formal learning environments, the present study extends this framework by showing how motivation toward biology is reshaped beyond schooling, influenced by professional demands, health-related concerns, and environmental awareness. This contributes new qualitative evidence to address the lack of longitudinal insight into motivational processes in biology education.

In line with Osher's [30] ecological and developmental perspective on learning, the findings of this study further demonstrate that biology education cannot be meaningfully understood in isolation from the broader life contexts in which learners are embedded. Participants' narratives indicate that transitions between educational stages and the shift into adulthood do not merely represent administrative or chronological changes, but instead function as critical turning points that reshape how biology knowledge is valued, interpreted, and applied in everyday life. These transitions often coincide with changes in personal responsibilities, social roles, and professional demands, which in turn influence learners' engagement with biological concepts. Building on Osher's work, this study provides empirical evidence that developmental contexts interact dynamically with discipline-specific learning over time, illustrating how the relevance and significance of biology education evolve in response to timing and life circumstances. By foregrounding learners' subjective interpretations of these transitions, the findings highlight that educational meaning-making is a continuous and context-dependent process rather than a fixed outcome of formal instruction. Such insights respond directly to the limited application of life course perspectives in biology education research and underscore the importance of examining how learning trajectories unfold across the lifespan.

Importantly, the findings challenge implicit assumptions in the literature that the meaning of biology education is fully established during formal schooling. Rather than being fixed at the point of instruction, participants' accounts indicate that meaning-making related to biology learning is often delayed, fluid, and strongly shaped by changing life contexts. Biological knowledge acquired earlier in formal educational settings was frequently reinterpreted and gained renewed significance later in life, particularly when individuals encountered personal, social, or professional situations in which such knowledge became practically relevant. This suggests that the impact of biology education may unfold over extended periods of time, highlighting the importance of considering context-dependent and longitudinal dimensions of learning beyond formal educational boundaries. This extends the work of Cleveland [29] and Glynn [31] by situating relevance and motivation within a life course framework, demonstrating that their influence may emerge long after formal instruction has ended.

By integrating Cleveland's focus on relevance, Glynn's By emphasizing motivation as a dynamic and context-sensitive process and situating biology learning within a developmental and contextual framework, this study contributes theoretically to bridging previously fragmented strands of biology education research. Specifically, it addresses a notable gap in the literature by reconceptualizing biology

learning not as a series of isolated educational events confined to particular instructional settings, but as a longitudinal life course process that unfolds across multiple educational stages and life contexts. In doing so, the study moves beyond dominant cross-sectional models that prioritize short-term outcomes, offering instead a more holistic understanding of how biology education supports sustained engagement, evolving motivation, and ongoing meaning-making across the lifespan.

Overall, these findings suggest that future biology education research should move beyond predominantly cross-sectional designs and adopt longitudinal, theory-driven approaches that are capable of capturing learning trajectories, educational transitions, and evolving meaning-making processes across different life stages. For educational practice, the results reinforce the importance of designing biology curricula and pedagogical strategies that consistently emphasize relevance to learners' lives, provide sustained motivational support, and ensure contextual continuity across educational levels, thereby fostering deeper and more enduring engagement with biological knowledge over time by Cleveland [29], Osher [30], and Glynn [31] for learning environments that support learners' development beyond immediate academic outcomes.

## CONCLUSION

This study addressed a critical gap in biology education research by examining biology learning as a longitudinal and life course process rather than as a series of isolated instructional experiences. Through a qualitative exploration of learning trajectories, educational transitions, and evolving meaning-making across life stages, the findings demonstrate that engagement with biology education develops cumulatively and is shaped by both early educational encounters and later life contexts. Early experiences function as foundational reference points that influence long-term orientations toward biology, although their effects are neither fixed nor uniform, as biological knowledge is often reinterpreted and gains relevance in response to changing personal, social, and professional circumstances. The study further reveals that engagement with biology is dynamic and non-linear, with motivation and interest fluctuating across educational and life transitions that operate as critical turning points in learning trajectories. By adopting a life course perspective, this study contributes to a more holistic theoretical understanding of biology education as a developmental process extending beyond formal schooling, demonstrates the value of qualitative approaches for capturing delayed and context-dependent learning outcomes, and highlights the importance of designing biology education that emphasizes continuity, relevance, and sustained opportunities for meaning-making across the lifespan.

## LIMITATIONS

This study is subject to several important limitations that should be considered when interpreting the findings. First, its qualitative life-history design, combined with a relatively small sample of twelve purposively selected participants, restricts the generalizability of the results to broader populations or different educational systems, despite the use of maximum variation sampling to capture diverse trajectories. In addition, the retrospective nature of the interviews introduces potential recall bias, as participants reconstructed earlier educational experiences from memory, which may have been selectively remembered, unconsciously reinterpreted, or influenced by their current life circumstances. The study also lacks cross-cultural or institutional comparison, meaning that the learning trajectories identified here may reflect context-specific dynamics rather than

patterns applicable across different countries or curriculum structures. Furthermore, the reliance on self-reported narratives without triangulation through classroom observations, teacher perspectives, or documentary evidence limits the robustness and ecological validity of the findings, as the study captures participants' meanings rather than directly observing biology learning processes. Finally, while the thematic narrative analysis provided rich insights into developmental patterns, the absence of analytic software and the exclusive focus on past experiences rather than real-time learning behaviors reduce the study's replicability and temporal precision, indicating the need for future research employing mixed-methods, longitudinal tracking, and cross-context comparisons to deepen and broaden understanding of biology learning across the life course.

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## AUTHORS CONTRIBUTION

E.N.N. conceptualized the study, led the data analysis, and wrote the manuscript. B.D. contributed to the study design, interview protocol development, and provided insights during analysis. S. contributed to the theoretical framework and interpretation of results, while A.W. helped with data collection, transcription, and manuscript review.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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